Designation: D 5140 – 95

An American National Standard

Standard Guide for Testing Polyurethane "Poured in Place" Thermal Break Materials[1,2]

This standard is issued under the fixed designation D 5140; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers the preparation of a standard-size test sample and basic tests for physical property determinations of solid thermal break materials.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

NOTE 1—There is no similar or equivalent ISO standard.

1.3 The following precautionary caveat pertains only to the test method portion, Sections 6 and 14, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[3]

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus[3]

C 1045 Practice for Calculating Thermal Transmission Properties from Steady-State Heat Flux Measurements[4]

D 256 Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials[5]

D 297 Test Methods for Rubber Products—Chemical Analysis[6]

D 638M Test Method for Tensile Properties of Plastics [Metric][5]

D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics[4]

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials[4]

D 792 Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement[4]

D 883 Terminology Relating to Plastics[4]

D 1600 Terminology for Abbreviated Terms Relating to Plastics[4]

D 1622 Test Method for Apparent Density of Rigid Cellular Plastics[4]

D 2240 Test Method for Rubber Property—Durometer Hardness[5]

E 228 Test Method for Linear Thermal Expansion of Solid Materials with a Vitreous Silica Dilatometer[7]

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminologies D 883 and D 1600, unless otherwise indicated.

3.2 *Descriptions of Terms Specific to This Standard:*

3.2.1 *thermal break, n*—a solid or cellular material, or combination of materials, of low thermal transmission placed between components of high thermal transmission in order to reduce the heat flow across the assembly.

[1] This guide is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved June 15, 1995. Published August 1995. Last previous edition D 5140 – 90. Last previous edition D 5140 – 90.

[3] *Annual Book of ASTM Standards*, Vol 04.06.

[4] This guide was revised to include an ISO equivalency statement and a section on Keywords.

[5] *Annual Book of ASTM Standards*, Vol 08.01.

[6] *Annual Book of ASTM Standards*, Vol 09.01.

[7] *Annual Book of ASTM Standards*, Vol 14.02

4. Significance and Use

4.1 Tests made on thermal break materials can be of considerable value in comparing physical properties of different materials, in controlling manufacturing processes, and as a basis for writing specifications.

5. Sampling

5.1 Test samples can be made in an aluminum mold in accordance with the manufacturer's recommended procedures. The recommended mold sizes are 305 by 152 by 6.2 mm (12 by 6 by ¼ in.) or, 305 by 152 by 12.5 mm (12 by 6 by ½ in.).

5.2 Because of the effect on physical properties, the mold temperature used in the sample preparation shall be 23 ± 2°C (73.4 ± 3.6°F).

5.3 The test sample for reference purposes shall be allowed to age a minimum of seven days at 23 ± 2°C (73.4± 3.6°F) and 50 ± 5 % relative humidity before testing.

6. Density

6.1 Determine the apparent overall density of the molded product in accordance with Test Method D 1622.

6.2 *Report*—Report the following information:

6.2.1 Apparent density, to the nearest 1.6 kg/m^3 (0.10 lb/ft^3), and

6.2.2 Section thickness.

7. Specific Gravity

7.1 Determine the specific gravity of regular- or irregular-shaped materials in accordance with Test Methods D 792.

8. Tensile Properties

8.1 Determine the tensile and elongation in accordance with Test Method D 638M, specimen Type I. The test specimens shall be cut from the 6.3-mm (¼-in.) sample and the crosshead speed shall be 5 mm (0.2 in.)/min. Report the tensile, elongation, any yield point, and percent strain at yield point if present.

9. Hardness

9.1 Determine the hardness in accordance with Test Method D 2240 on the 6.3-mm (¼-in.) thick sample. Report the initial and 5-s drift value determined on the top and bottom surfaces. If the determination is to be made at subnormal temperatures, condition the instrument at the same temperature. To prevent moisture from damaging the instrument, it is advisable to place the tester directly in a desiccator after removing from the cold box.

10. Impact Strength

10.1 Determine the brittle impact properties in accordance with Method A of Test Methods D 256 on the 6.3-mm (¼-in.) with a notch cut on the molded or uncut surface of the specimen.

11. Flexural Modulus

11.1 Determine flexural modulus using the general procedure in Test Methods D 790, Method I.

11.2 The following test parameters are recommended for thermal break materials:

11.2.1 *Specimen Size:*

Length—130 mm (5 in.)

Width—13 mm (½ in.)

Thickness—6.4 mm (¼in.)

Span—100 mm (4 in.).

11.2.2 *Rate of Crosshead Motion*—0.20± 0.02 mm/s (0.5 ± 0.05 in./min). Calculate the tangent modulus of elasticity. See 11.1.1 in Test Methods D 790.

NOTE 2—When calculating slope, use the steepest tangent as shown in Fig. 1 of Test Methods D 790.

NOTE 3—The crosshead rate of 0.2 mm/s (0.5 in./min) differs from the rate of 0.02 mm/s (0.05 in./min) specified in Test Methods D 790. Test data has shown that the faster rate provides a lower coefficient of variation than does the slower rate.

11.2.3 Condition a specimen at the test temperature for a minimum of 30 min. Recommended temperatures are −29, −18, 22, 49, and 71°C (−20, 0, 72, 120, and 160°F).

12. Ash

12.1 Determine the percent ash in the sample in accordance with the section entitled Fillers, Referee Ash Method in Test Methods D 297.

13. Thermal Conductivity

13.1 Determine the thermal transmission properties in accordance with Test Method C 177 or Test Method C 518 and in conformance with Practice C 1045. Depending upon the size requirement of the tester, special samples may need to be prepared. The customer shall specify the mean temperature and ΔT.

14. Thermal Expansion

14.1 Determine the coefficient of linear thermal expansion in accordance with Test Method E 228 or Test Method D 696 using the 6.3-mm (¼-in.) thick sample. This test specifies a temperature range from −30 to +30°C (−22 to 86°F). Broader temperature range may be tested, however, the results may not be linear.

14.2 Report the percent change of the specimen at room temperature for the purpose of correlation with cyclic thermal testing.

15. Keywords

15.1 heat flow; polyurethane; thermal break; thermal conductivity